Stroke System-of- Care Plan

Mississippi State Department of Health

Bureau of Acute Care Systems

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Executive Summary

A Stroke System needs to organize stroke treatment resources within the system in order to allow and optimize treatment of the stroke patient in the shortest period of time. As such, a system would deliver the patient suffering symptoms of acute stroke to the nearest hospital with resources capable of initially treating a stroke patient with IV thrombolytic medication according to national standards of care. The system would then allow the stroke patient to remain at that hospital or facilitate transfer for higher level of stroke care if stroke specialist/neurological consultation is not available at that hospital via phone or telemedicine, there is need for further endovascular or invasive therapy not offered at that hospital, or Neurosurgical support is needed. As a system, all care would be facilitated by hospital and EMS evidence-based treatment protocols; hospitals would be classified by ability to treat and care for stroke patients; and performance improvement measures would be analyzed in both EMS and hospital care to improve and maintain standards of care.

Introduction to the Clinical Problem

In 2007, Mississippi had an estimated population of 2.9 million people, with over 1.6 million living in a rural community (Rural Assistance Center, 2007). Stroke is the fifth leading cause of death in Mississippi, accounting for 5.3% of all deaths (Mississippi Statistically Automated Health Resource System [MSTAHRS] Report, 2010). Much of this death is premature: nearly one in five of all stroke deaths occur in Mississippians under 65 years of age. Mississippi's stroke mortality rate is the fifth highest in the nation, ranking behind Arkansas, South Carolina, Tennessee, and Alabama. Stroke death rates in Mississippi are falling slightly faster than the national average, but remain 23.8% higher than the overall U.S. rate. Therefore, it is critical that stroke care in Mississippi be a central focus for healthcare leaders.

In Mississippi, most of the specialty physicians, like neurologists, are located in select large medical centers; therefore, access to a stroke specialist is a primary concern in stroke care. This makes following the latest evidence-based practice guidelines related to stroke care important. According to the American Stroke Association, from the NINDS rt-PA Stroke Trial (1997), timely intervention in acute ischemic stroke offers significant reductions in neurological deficits and disability. Most community hospitals do not have access to a neurologist and lack the expertise found in a Stroke Center. Establishment of a stroke team in rural community hospitals is not feasible, due to physician shortage and financial constraints (Levin & Gorman, 1999). Unlike trauma and STEMI systems of care, where it is essential to get the patient to a specialty facility in the shortest amount of time, stroke care can be initiated at the rural facility in conjunction with input from a practitioner trained in stroke care, either by telephone or telemedicine. A careful patient history and examination, laboratory analysis, and a head CT can be done at "Stroke-Ready" hospitals, allowing the timely decision to treat the

patient with thrombolytic therapy at that hospital before transfer to a “Stroke Center” (“drip-n-ship”) if needed for Neurological, Neurosurgical, or Neurointerventional support.

Objectives

Stroke patients should be recognized as quickly as possible to identify those eligible for thrombolytic therapy. Research has shown that both morbidity and mortality can be reduced by the approach of rapid reperfusion soon after the onset of symptoms.

Emergency Medical Services (EMS) personnel must be trained to recognize and transport stroke patients in a timely manner. The goal should be to:

- Recognize potential stroke patients in the field.
- Early activation and notification to the receiving hospital.
- Rapidly transport to a Stroke-Ready hospital or to a Stroke Center.

Every hospital providing care to stroke patients will have a recognized stroke plan that defines the optimal treatment pathways.

- Response systems, including optimal time frames, must be maintained and monitored from EMS recognition to emergency department (ED) arrival to completion of specific laboratory data and head CT.
- Patients who meet thrombolytic criteria should have access to neurology expertise as quickly as possible, which could be via telemedicine.
- A system to rapidly transfer stroke patients to a Stroke Center should be established.
- Health professional training programs should be enhanced to include standards of stroke recognition and management.

System Components and Organization

The Stroke System is comprised of a number of separate components which are organized and work together as a system. The individual components and elements are described below:

- Pre-Hospital Component – EMS units are an integral part of the Stroke System. All EMTs and Paramedics should have a basic knowledge and awareness of the Stroke System elements and system function. Specifically, this knowledge refers to entry criteria (identification of a stroke), triage and destination guidelines, and communication procedures. On-line and off-line medical control physicians will also need to be aware of the Stroke System elements and system function.

- Hospital Component – There are two categories for participating hospitals:

1. Stroke-Ready Hospitals – These Level 3 facilities would have the ability to examine and perform diagnostic testing (laboratory and CT), but do not necessarily have neurology expertise present or all of the treatment components for definitive stroke care.

2. Stroke Centers – These include Level 1 and 2 facilities. Capabilities would be verified by the Mississippi State Department of Health (MSDH), but would include characteristics as defined by the Brain Attack Coalition (*Stroke* 2005; 36:1597-1618) for both non-invasive and invasive care, and include all phases of definitive stroke care, including acute and rehabilitative phases. (Refer to Appendix A for a detailed listing of clinical requirements.)

- Hospitals may participate in the Stroke System on a voluntary basis, but must meet the standards as defined in Appendix A. Each hospital would determine whether they are available to receive patients or on critical care diversion.

- The decision to participate must be made jointly by both the hospital administration and medical staff. A written commitment in the form of a resolution passed by the appropriate quorum of the governing authority of the hospital, and co-signed by the director of the medical staff, signifies the facility's desire to participate in the system.

- Each Level 1 and 2 Stroke Center must have a neurologist director responsible for oversight of the Stroke Program.

    - Stroke Program Directors are responsible for developing and maintaining basic stroke care protocols for the hospital.

    - Stroke Program Directors also have oversight responsibility for the stroke component of the hospital Performance Improvement (PI) program.

- Each Level 3 hospital must have a physician director for oversight of the Stroke Program.

    - Stroke Program Directors are responsible for developing and maintaining basic stroke care protocols for the hospital.

- Communication Component – Communications are critical to the function of the Stroke System. Communications provide 1) essential knowledge of the overall status of pre-hospital stroke activities and hospital resource availability on a continual basis; 2) access to system organization and function protocols whenever such information is requested by pre-hospital or hospital-based personnel; 3) a link between the Level 3 hospital and the Level 1 or 2 Stroke Center and 4) collection of uniform system-wide data for PI activities and development of a statewide stroke database.

- Performance Improvement (PI) Component – This component is essential to the Stroke System to document continuing function and allows the implementation of improvements in a system where patients may not have the ability to make their own personal care choices, and depend on the system for appropriateness of care. The efficacy of the initial care in stroke patients plays a pivotal role in determining their outcomes. Therefore, there is a requirement to evaluate the system on a continual basis to determine the effectiveness of stroke care and system performance.

    1. This component uses the American Heart Association's "Get with the Guidelines Stroke" database, which provides an overall look at stroke emergencies, care and outcomes, provides information for use in determining and developing stroke teaching programs, and provides information for potential research studies.

    2. The PI process involves specific steps at each level of care within the system. System-wide evaluation will be the responsibility of the Stroke Sub-committee of the State PI Committee. In hospitals, a multi-disciplinary peer review process must occur and must review both medical care and Stroke Center function. Pre-hospital evaluation will normally be conducted by the EMS provider. A more detailed outline of the PI Program is contained in Appendix B.

- Mississippi Stroke Advisory Committee (MSAC) – The MSAC will be established by the Mississippi State Board of Health. This committee will have the responsibility for system guidance and governance, which will occur through regulatory development. Detailed information on the MSAC is contained in Appendix C.

System Function

General function of the system will follow the scenario of:

- Stroke event occurs or warning signs/symptoms are present; 9-1-1 is called.

- Field triage is conducted by EMS personnel, who determine if the patient meets system entry criteria based on administration of a universal stroke scale. When a patient meets system entry criteria, EMS priorities are early notification and transport to the nearest hospital with an appropriate level of stroke care.

- In an ideal situation, if assistance with patient designation is needed, EMS will contact their Medical Control who will use a Stroke Center resource tracking tool (State Medical Asset Resource Tracking Tool [SMARTT] or similar program) along with patient location to determine the appropriate initial care for the patient based on an established algorithm. (Refer to Appendix D for Pre-Hospital Stroke Protocols.)

- The EMS unit will establish contact with the destination hospital to give advanced notification.

- Patient is transported to the destination hospital, which initiates their response protocol.

- If the patient is transported by private vehicle to a hospital, the patient will be rapidly triaged by the hospital and initiated into the hospital stroke treatment response protocol.

- Patient undergoes initial evaluation for thrombolytic administration which includes, but is not limited to, time of onset, history, physical exam, laboratory testing, and head CT.

- The hospital reviews time of onset, history and physical exam, laboratory results and CT findings. Intravenous (IV) Alteplase is considered in a patient presenting within three (3) hours of onset of symptoms and is administered immediately, if appropriate. Select patients may be considered for thrombolytics with four and a half (4.5) hours of symptom onset based on AHA and AAN practice statement.

- If a higher level of stroke care is needed, the patient is transferred to a Level 1 or 2 Stroke Center based on hospital affiliation, location, and transfer algorithm.

System Operations

System operations refer to the activities that occur after it is determined that a patient meets system entry criteria and communications have been established within the system.

- Hospital Operations

    - Hospital stroke management is an essential part of any stroke system. This phase of stroke care requires adequate resources (equipment and facilities) and personnel with training and commitment to carry out rapid initial assessment, stabilization, and initial care.

- Hospitals will be classified into one of four levels of care based on resources available as outlined in Appendix A.

- Initial hospital destination will be determined by the closest available hospital appropriate to the patient's level of care or the patient's choice. Hospital status will be determined by using a Stroke System resource tracking tool. For simplicity, hospitals will be assigned status based on pre-determined levels of care.

- In the event a patient or family member requests transport to a specific facility that does not meet system destination guidelines, EMS and/or Medical Control will make a reasonable effort to convince the patient to avail themselves of the Stroke System plan.

- In the event that multiple hospitals able to provide optimal level of stroke care are available in the same geographic area, patient transport/transfer may rotate between those centers in an equitable basis (i.e., daily, weekly, or per patient), or patient preference will prevail.

- If the patient is unstable (inadequate spontaneous ventilations without a secured airway or in cardiac arrest), the patient should be transported to the nearest hospital, regardless of stroke center level (a secured airway includes any airway device that allows adequate ventilation and oxygenation).

- Inter-facility transfers – In the event a stroke patient is received by a Level 4 hospital, or a hospital without current capacity or appropriate resources for the patient, the patient should be transferred to a hospital with increased level of stroke capabilities. Any hospital participating in the Stroke System which is a Level 1 or 2 Stroke Center agrees to accept stroke inter-facility transfers upon request by a transferring hospital regardless of the patient's race, sex, creed, or ability to pay.

- Not all ischemic and hemorrhagic stroke patients require transfer to higher level (Level 1) centers. However, some acute ischemic and hemorrhagic stroke patients will need higher level of care hospital to hospital transfer for post thrombolytic management, acute Neurointerventional procedure (ischemic stroke rescue/ cerebral aneurysm), or acute Neurosurgical procedure. In these cases, Level 1 Stroke Centers will accept the acute stroke patient that is in need of transfer for higher level of care regardless of hospital census. However, if the Neurointerventional or Neurosurgical team is not able to provide prompt treatment, it is acceptable to redirect a stroke patient to

another Level 1 Center.

- Pre-hospital Activities
    - Pre-hospital care will be carried out in compliance with the Mississippi Model Protocols and the EMS provider's Medical Control Plan.
    - Stroke patients are best served by rapid transport to the most appropriate facility. Field time should be kept to a minimum; however, pre-hospital care should not be sacrificed for less time on scene.

Appendix A: Stroke Hospital Standards

Level 1--

- Consists of a core team of personnel, infrastructure, and expertise to diagnose and treat stroke patients who require intensive medical, surgical, and interventional vascular care. The team consists of a neurologist, neurosurgeon, and endovascular specialists.
- Fully equipped Emergency Department (ED) for rapid diagnosis and treatment using standard CT imaging within 25 minutes and ability to have results reported within 45 minutes of test completion.
- Lab services available 24/7 with appropriate result reporting.
- Neurology, Neurosurgery, and Endovascular specialists available 24/7.
- Intensive Care capability available with critical care specialist available 24/7.
- Complete rehabilitation services (physical therapy, occupational therapy, and speech therapy) staffed by trained professionals and available for all patients within 24 to 48 hours of admission.
- Readily available for transfer of patient from field or lower care facility.
- Maintenance of adequate helicopter landing site on campus.
- Operating room and appropriate support staff available 24/7 for emergency surgery when necessary.
- Radiologic and diagnostic imaging with expedited reporting available 24/7, this should include angiography with endovascular capabilities.
- Must participate in the American Heart Association (AHA) “Get With The Guidelines” (GWTG) Stroke Registry. A multi-disciplinary quality improvement team, should meet at least quarterly to review data and lead quality improvement initiatives.
- Stroke team members must document at least eight hours of Continuing Medical Education (CME) annually.
- Community and professional educational projects should be ongoing.

Level 2 -- *(must have all of the requirements of Level 1 EXCLUDING endovascular capabilities)*

- Consists of a core team of personnel, infrastructure, and expertise to diagnose and treat stroke patients who require intensive medical and surgical care. The team consists of a diagnostic radiologist, neurologist, and neurosurgeon. Fully equipped ED for rapid diagnosis and treatment using standard CT imaging within 25 minutes and ability to have results reported within 45 minutes of test completion.
- Lab services available 24/7 with appropriate result reporting.
- Radiology, Neurology, and Neurosurgery specialists available 24/7.
- Intensive Care capability available with critical care specialist available 24/7.

- Complete rehab services (physical therapy, occupational therapy and speech therapy) staffed by trained professionals and available for all patients within 24 to 48 hours of admission.
- Readily available for transfer of patient from field or lower care facility.
- Maintenance of adequate helicopter landing site on campus.
- Operating room and appropriate support staff available 24/7 for emergency surgery when necessary.
- Radiologic and diagnostic imaging with expedited reporting available 24/7.
- Must participate in the AHA GWTG Stroke Registry. A multi-disciplinary quality improvement team should meet to review data and lead quality improvement initiatives at least quarterly.
- Stroke team members must document at least eight hours of CME annually.
- Community and professional educational projects should be ongoing.

Level 3 -- *(must have the ability to diagnose and stabilize patient for transfer to Level 1 or 2 Referring Center)*

- ED physician, other qualified physician, or physician extender available 24/7 to diagnose and initiate appropriate treatment.
- Rapid diagnosis and treatment using standard CT imaging within 25 minutes and ability to have results reported within 45 minutes of test completion.
- Lab services available 24/7 with appropriate result reporting.
- Acute stroke-trained providers should be available 24/7 to direct IV Alteplase (t-PA) administration.
- Transition plans must be established for rapid transfer of patient to Level 1 or 2 Stroke Center. Factors that may necessitate transfer include:
    - Consider utilizing “Drip and Ship” after initiation of Alteplase if neurosurgery coverage is not available.
    - Patients with rapid clinical decline.
    - Patients without response to IV Alteplase or outside IV Alteplase window who may benefit from neuro intervention.
    - Other factors as clinically necessary.
- Must participate in the AHA GWTG Stroke Registry. A multi-disciplinary quality improvement team should meet to review data and lead quality improvement initiatives at least quarterly.
- Community and professional educational projects should be ongoing.

Level 4 -- Non Stroke Hospital

- Facility is able to assess and evaluate for possible stroke, but lacks essential components to treat patient with IV thrombolytics.
- Transition plans must be established to facilitate rapid transfer of patient to Level 1 or 2 Stroke Center.

- May be bypassed in accordance with this plan or an EMS Medical Control Plan.

Appendix B: Performance Improvement (PI)

Performance Improvement is a vital part of the Stroke System. It is used to document continuing proper function of the system and evaluation of that function to implement improvements in system operation and stroke patient management. In a Stroke System, patients have virtually no time to make specific choices regarding acute and critical medical care. Therefore, the system has a moral obligation to perform evaluation functions to assure that the highest level of care is being provided, and that improvements are implemented whenever possible in a timely manner.

The PI program will be system-wide. Every participating hospital and EMS provider is required to participate in the system PI process. The appropriateness, quality, and quantity of all activities of the Stroke System must be continuously evaluated.

- The Stroke PI Sub-committee of the State PI Committee will be responsible for the PI oversight of the Stroke System.
    - The Stroke PI Sub-committee will be chaired by a neurologist participating in the Stroke System.
    - Each Level 1 and 2 Stroke Center will be authorized an administrative and/or clinical representative on the Stroke PI Sub-committee.
    - Level 3 hospitals may participate in the Stroke PI Sub-committee. The number of representatives will be determined by the permanent members of the sub-committee.
    - Three EMS organizations will be authorized a representative: one each from a hospital-based EMS provider, a private EMS provider, and public/government EMS provider.
- Specific audit filters will be established by the Stroke PI Sub-committee.

In general, the following processes should be performed by each agency or organization. The results of these reviews will be reported to the Stroke PI Sub-committee.

- Each organization assigns a PI person to oversee the process
- Determine audit filters
- Collect data
- Evaluate data
- Determine system-of-care issues present

Develop corrective action plan (CAP)

- Re-evaluation to document results/effectiveness of CAP

Specific items for evaluation:

- Pre-hospital:
    - Quality measures regarding response times (time to dispatch, EMS response, on-scene time, and total transport time) will be collected and analyzed.
    - Accuracy of patient assessment
    - Transport protocol adherence
    - Procedures initiated/completed
    - Medical control interaction
    - Transport mode (air/ground)
    - Record/documentation
    - Inter-facility care/transport safety
- Hospital:
    - Protocol adherence
    - Outcome review
        - Complications
        - Deaths
    - Achievement of time sensitive goals
        - CT completion and reporting times
        - Door to Alteplase administration times
    - Core stroke quality measures established for hospital stroke care will be entered into the GWTG Stroke registry for blinded comparison between hospitals
- Regional system:
    - Communications/notifications

- Triage
- Protocol adherence

Appendix C: Mississippi Stroke Advisory Committee (MSAC)

The Mississippi Stroke Advisory Committee (MSAC) will be established by the Mississippi State Board of Health for the purpose of providing guidance and direction to the Department in the implementation and execution of the state Stroke Plan.

- The committee will be chaired by a Neurologist participating in the Stroke System.
- Committee membership will be comprised of at least one representative from the following groups:
    - Emergency Medicine physician
    - Emergency Nursing
    - Hospital Administration
    - Neurology
    - Interventional Neurology/Radiology/Neurosurgery
    - Stroke Nursing
    - Stroke Registry personnel
    - EMS Provider (ALS)
    - EMS Administration

The term of membership is three years, with the term of the Chairman offset from the other members. Optimally, there will be 18-24 members of the MSAC.

The MSAC will meet quarterly or as required. Meetings of the MSAC may be independent or may be combined with other advisory committees such as the Mississippi Trauma Advisory Committee (MTAC) and Emergency Medical Services Advisory Council (EMSAC).

Appendix D: Pre-hospital Stroke Protocol

1) Initial assessment, transport ASAP:
   ABCs
   Obtain time of symptom onset (**Last time known well**)_____;
   Source of information_____;
   Contact information_____.

2) Administer high concentration oxygen, as needed, to maintain O2 Sat >94 percent.

3) Position patient with head/shoulders elevated to 15-30 degrees (unless contraindicated).

4) Maintain NPO.

5) Blood glucose < 60, treat per protocol.

6) Do not treat high blood pressure without physician approval.

7) Perform Stroke Scale – Cincinnati Stroke Scale.

8) Transport patient to the appropriate facility:

   a. Transport patient to the closest Level 1, 2, or 3 hospital capable of treating the patient with IV Alteplase. Hospitals not able to diagnose and treat stroke patients (Level 4 hospitals) may be by-passed. EMS may use discretion based on transport time or other unforeseen factors.
   b. Consider transport of the stroke patient with severe symptoms (hemiplegia, aphasia, neglect, stably intubated) to a Level 1 Stroke Center if symptom onset to hospital arrival time is greater than 3 hours and less than 6 hours.
   c. Transport patient to the closest appropriate facility if unstable (e.g., cardiac arrest, unstable airway).

9) IV NS KVO once en route.

10) EKG once en route.

11) Notify receiving facility of estimated arrival time of acute stroke patient, Stroke Scale finding, and time of onset.

Appendix E: Alteplase (t-PA) "Drip and Ship" Transfer Protocol for Ischemic Stroke

**********Use only **Alteplase**********

1) Symptom onset time:_____(**Last time known well**).
2) Document BP < 180/105 prior to departure:_____.
3) Initial NIHSS_____; NIHSS at departure: _____ (scored by ER physician/staff).
4) Activate EMS for transfer (consider air transport).
5) Two (2) peripheral IVs (18 gauge, AC or higher, if possible).
6) Time t-PA initiated: Total dose:_____, weight (kg)_____.
    a. Bolus dose time:_____, Dose_____mg.
    b. Infusion dose time:_____, Dose_____mg. (1 hour infusion)
    c. Completion time:_____.
7) After t-PA infusion completed, start NS at 80cc/hr to infuse remaining t-PA in tubing.
8) O2 as necessary to maintain O2 sat > 94%.
9) HOB 15-30 degrees (unless contraindicated).
10) If IV infusion blood pressure medication has been initiated, record:
    a. Medication_____; current dose_____.
    b. Titration instructions to maintain BP < 180/105:

        _____.
    c. Hold infusion blood pressure medication for BP < 140/80.
11) Vitals and neuro checks every 5 minutes.
12) Hypertension: If BP > 180/105.
    a. HR > 60: Labetalol 10mg IV over 2 minutes, repeat as needed after 5 minutes. May repeat 3 times.
    b. HR < 60: Nicardipine (Cardene) 5 mg/hour (at a concentration of 0.1 mg/ml); increased by 2.5 mg/hour every 15 minutes to a

maximum of 15 mg/hour; consider reduction to 3 mg/hour after response is achieved.

13) Stop t-PA for:

    a. Neurologic deterioration.

    b. Airway edema.

    c. Time discontinued:_____.